

STAVATTI™

WHITE PAPER

REGARDING:

Cold Plasma Cavity Active Stealth Technology

A PROPRIETARY DEVELOPMENT OF STAVATTI™

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14. ABSTRACT STAVATTI MILITARY AEROSPACE has undertaken the development of a proprietary mechanism by which to reduce the RCS of aerospace and surface vehicles. Identified as "Cold Plasma Cavity Active Stealth Technology" by STAVATTI, this mechanism permits the reduction of aircraft RCS largely independent of external airframe/vehicle and configuration. This mechanism is appropriate for aircraft/vehicles requiring all-aspect RCS reduction, as well as those destined for export to a wide variety of allied air forces/militaries as it enables a "stealth aircraft/vehicles" to be reconfigured to a non-stealth configuration through the removal of critical Line Removable Units (LRUs) responsible for the generation and management of the cold plasma responsible for electromagnetic attenuation.						
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INTRODUCTION

STAVATTI weapon systems are eloquent and capable. The trademark difference between STAVATTI systems and those of nearest competitors is the unrelenting insistence placed upon merging form and function to deliver unparalleled performance. The result are weapons which are articles of defense and objects of desire.

In maintenance of that standard, STAVATTI was required to conceive a method for reducing the "balanced observables" of our military aircraft in a manner which would not negatively impact either the aesthetics or aerodynamic attributes of the vehicle. As an enterprise focused upon the Direct Commercial Sale (DCS) of commercially developed defense systems to NATO allies, an additional requirement rested upon the creation of low observable mechanisms which could be cleared for export or removed from those weapon systems to be procured by allied nations restricted from receiving low observable technology due to National Disclosure Policy (Taiwan ROC, India, etc.).

The culmination of STAVATTI's approach to "exportable" military aircraft reduced balanced observables, is reflected in the F-26 STALMA™ Multi-Role Fighter configuration and design. Although featuring a degree of faceting and wing-body blending as employed in the F-117 and B-2 respectively, the F-26 employs largely conventional airfoils and fuselage surfaces which would traditionally result in a greater than desired Radar Cross Section (RCS). To reduce overall aircraft radar signature, the RCS reduction methodology employed in the STALMA progressed far beyond faceting and blending. Similarly, use of an axisymmetric thrust vectoring nozzle attached to a relatively "stock" Pratt & Whitney F119 turbofan, mandated the application of unique and innovative methods to reduce IR, aural and visual smoke signatures. In short, the STALMA integrates a variety of innovative, STAVATTI proprietary approaches to reduced balanced observables, ultimately resulting in what is identified as "Sixth Generation Stealth Technology."

SCOPE

This white paper concentrates upon only one aspect of reduced balanced observables: RCS. Herein is summarized a STAVATTI method for military aircraft RCS reduction which is largely independent of air-frame shape and external configuration. This method is appropriate for aircraft requiring all-aspect RCS reduction, as well as those destined for export to a wide variety of allied air forces, as it enables a "stealth fighter" to be reconfigured to a non-stealth configuration through the removal of critical Line Removable Units (LRUs). This RCS reduction approach has been dubbed by STAVATTI as **Cold Plasma Cavity Active Stealth Technology (COPCAST)**. COPCAST™ is a trademark of STAVATTI.

COPCAST is a primary mechanism for the all-aspect reduction of RCS/Electromagnetic Signature for the F-26 STALMA and additional commercially developed military and special access STAVATTI platforms. COPCAST has the potential to be applied to a variety of appropriately engineered aerospace vehicles, land vehicles and surface sea vessels for the purpose of RCS reduction.

This paper provides a basic discussion of STAVATTI COPCAST for general public domain disclosure purposes. Details regarding the technology/approach are held to the unclassified/unlimited/export approved level. Information relating to the STAVATTI approach to IR, Visual, Aural and Charge signature reduction as integrated components to reduced balanced observables, particularly with regard to the F-26 STALMA platform, is presented in alternate White Papers, Technical Reports and briefings.

BACKGROUND

Low Observable (LO) technology concentrates upon the reduction of radar/electromagnetic, infra-red, aural, visual and additional signatures of weapon systems. Balanced LO results in the reduction of all aspects of signature to as near equal a degree as possible. In reducing the balanced observables of an military aircraft, STAVATTI has concentrated upon limiting all signatures, including radar, infra-red, visual and aural to extremely low yet practical standards from a maintenance and reliability standpoint. This reduction requires a broad understanding of a variety of systems and technologies, resulting in a number of unique approaches and solutions. Focusing upon the radar/electromagnetic signature reduction aspect of LO technology, STAVATTI's COPCAST provides a means for effective, reduced all-aspect aircraft RCS.

Significant reduction of aircraft RCS has traditionally depended upon external shaping and to a lesser degree, material composition. Denys Overholser, responsible for leading the the RCS prediction program Echo 1 development team at Lockheed Skunk Works during *Have Blue* lists the four most critical factors in RCS reduction as being "shape, shape, shape and materials¹." The external shape/materials driven approach to stealth aircraft has resulted in the configuration of the A-12/SR-71, F-117, B-2, F/A-22, YF-23 and F/A-35 JSF. In all of these aircraft systems, the inadequacy of shaping to reduce RCS in all-aspects is mitigated through the use of Radar Absorbent Materials (RAM) in both external structure and coatings.

The Lockheed F-117 Nighthawk is one of the most dramatic examples where shaping was tailored to reduce RCS. Of faceted construction with wing and empennage surfaces of 67.5° and 20° leading edge sweep respectively, the F-117 is aerodynamically unstable, particularly in pitch. Constructed principally of aluminum with RAM applied to external skins, the F-117 employs a largely conventional internal structure including the use of two spar wings. While proven to serve as an excellent weapon system of very low RCS, the F-117 is known for its high takeoff and approach speeds of 165 Kts and 150 kts respectively despite a relatively low wing loading at MTOW of approximately 46 lbs/sq ft. These high speeds are in-part due to the aerodynamics of highly swept wings in combination with a close coupled empennage of relatively low volume coefficient as well as being the result of faceted wing airfoils.

Despite high stall speed, the F-117 demonstrates significantly high degrees of maneuverability, responsiveness and controllability due to four channel Fly-By-Wire (FBW). An extremely affordable aircraft, average per unit flyaway cost was estimated at only \$42.6 million. Responsible for hitting over 31% of the targets during the first day of war in Desert Storm I, one of the only major shortcomings of the F-117, aside from high maintainability requirements associated with RAM coatings, was the fact only 59 were procured with a 1991 potential order for 24 more aircraft being scrubbed.

The F-117 has been a highly successful stealth platform. Similarly, nearly all stealth aircraft as developed and produced by either Lockheed Martin or Northrop have proven to be extremely capable and effective systems including the A-12/SR-71 (with a total RCS of approximately 22 sq in) and the B-2. Unfortunately, nearly all of the stealth platforms presently fielded require significant maintenance attention with regard to RAM coatings and surface continuity, resulting in uniquely high support costs. Furthermore, the shape/materials approach to stealth has resulted in platforms which cannot be exported to a variety of customers under current National Disclosure Policy, nor can their signature reducing features be modified to enable the export of non-stealth variants. Finally the traditional approach to stealth significantly limits the aerodynamic configuration of a combat aircraft while not necessarily guaranteeing reduced detectability when subjected to a range of potential threat radars at a variety of aircraft flight attitudes.

Discussion of RCS reduction theory and results due to shaping/materials is beyond the scope of this document, as is a general discussion of radar theory. Those familiar with developments within aerospace over the last 30 years likely recognize the advantages and shortcomings of the shape/materials based approach to RCS reduction. In producing superior solutions to the present LO state-of-the-art, STAVATTI has studied the approach to stealth utilized in the A-12/SR-71, F-117, B-2, F/A-22, YF-23 and F/A-35 programs to a great degree and can provide significant commentary with regard to our observation of lessons learned. Our election to embark on the development and application of a proprietary Cold Plasma Cavity active stealth technique stems directly from our analysis of what has been fielded, and what needs to be made available to NATO/allied customers worldwide.

Rather than rely upon external shaping or coatings, STAVATTI's Cold Plasma Cavity Active Stealth technique allows radar signals to pass through a bandpass external skin for absorption/scattering by an intelligently manipulated cold plasma maintained within the aircraft structure. The STAVATTI COPCAST approach enables an aircraft to be configured with any desired external shape, provided the external skin material permits the transmission of appropriate microwave wavelengths corresponding to threat radar frequencies and a means of generating and manipulating cold plasma is appropriately integrated within the aircraft. COPCAST places the heart of RCS reduction *inside* the aircraft and the direct result of interactions between a precisely controllable plasma within a defined internal cavity. In so doing, implementation of COPCAST requires a new approach to airframe structure design and assembly. This technique results in a systems level, Line Removable Unit (LRU) approach to stealth technology which is not only far more adaptable to a wider range of threats than current systems, but ultimately more affordable.

PLASMA ACTIVE STEALTH

An enterprise founded by physicists, STAVATTI is an environment which harbors great affinity toward quantum mechanical and atomic processes and how they may find direct application in advancing field able aerospace vehicles and weapon systems. Topics including plasma, nuclear, laser and information physics are of keen interest and as such, the application of plasma to result in a functional active stealth technology drew immediate attention and focus.

Active Stealth, also known as Active Cancellation, has traditionally been regarded as impractical due to the severe operational demands placed upon the system. Unlike shape and materials based stealth technologies which result in passive cancellation, active cancellation is an approach to handling multitudes of changing threat scenarios. Generally speaking, active cancellation consists of the reception and out-of-phase retransmission of threat radar signals. As such, most active cancellation models require the orchestration of dedicated and intelligently managed radar transmitters, receivers, antennas and power sources to cover all conceivable threat radar frequencies, angles, polarizations, etc. Active cancellation typically consists of three flavors including Fully Active, Semi Active and Deceptive.

In Fully Active cancellation, the stealth system receives, amplifies and retransmits threat radar signals out of phase with the original threat radar as well as the static RCS. Fully active systems adjust received threat radar signal amplitude, phase, frequency and polarization to adjust for alterations in threat signals. In Semi active cancellation, the stealth system does not amplify threat signals, but does permit the limited adjustment of retransmitted signal to compensate for changes in threat signal type. In Deceptive cancellation, threat radar energy is intercepted, intelligently modified and retransmitted to result in the reception of erroneous results by transmitting threat radar stations².

Although considered an active stealth technology, "plasma active stealth" is regarded by STAVATTI as a quasi-active system in which threat radar signals are received and absorbed/scattered by a plasma capable of absorbing/scattering a wide range of radar frequencies, angles, polarizations and power densities. Rather than actively sending threat radar signals directly back to the transmitter, the plasma within a plasma stealth system is more likely to scatter the radar energy, more akin to a faceted, passive surface approach. Never-the-less, plasma stealth is an active system with regard to the significant undetectability provided over a broad range of threat radar frequencies, polarities and transmission angles.

As indicated, plasma active stealth employs plasma within the principal scattering areas of the target so as to attenuate or absorb incident microwave (radar) energy/electromagnetic signals. Plasma, the fourth state of matter, is a nebulous collection of free electrically charged particles including negatively charged electrons and positively charged ions, resulting in a mixture of net neutral charge. Plasmas exist at a variety of temperatures, densities (representing the particle content per unit volume) and frequencies. Plasmas may be derived from a host of gas mixtures. A cold plasma of low density may be confined within glass tubing, while the extremely high temperature plasmas with densities of 10^{31}m^3 associated with stars are confined gravitationally.

Upon subjecting a suitable plasma to an external Electro-Magnetic (EM) field, the free electrons within the plasma will be displaced in accordance to the corresponding change in the EM fields. When the external EM field is relaxed, the displaced free electrons will oscillate at a distinct frequency amidst a comparatively static mass of positive ions. This oscillation will continue until damped by collisions and is known as the Plasma Frequency, f_p . Plasma Frequency is directly dependent upon Plasma Density. Expressing the Plasma Density in terms of the number of particles per cubic meter, an Electron Plasma Frequency in Hertz (Hz) may be realized from the following relationship:

$$f_p = 8.98(n_e)^{1/2} \quad (1)$$

whereby n_e is the electron density. Equation (1) may be employed to determine Ion Plasma Frequency also. Upon performing transformations on equation (1), a critical plasma density between single particle and collective interaction effect within the plasma can be realized from the following relationship:

$$n_e = 0.0124 f^2 \quad (2)$$

Equation (2) is useful, for if the electron density of a plasma is lower than the value provided by (2), a weak interaction between the incident threat EM/microwave/radar energy source frequency, frequency f , and the plasma occurs, resulting in the propagation of the EM energy via the plasma. If the plasma electron density is greater than the value provided in equation (2) the EM energy interacts intensely with the individual plasma particles to result in its net absorption or refraction by the plasma. Hence the critical plasma density necessary to absorb or scatter radar energy of specific frequencies, or up to a particular frequency threshold, may be determined, allowing one to tailor a plasma based stealth system based upon threat frequencies.

Based upon a discussion of plasma propagation, it can also be shown that radar energy with a higher frequency than the plasma frequency will propagate unattenuated within the plasma. Radar waves with a frequency less than or equal to the plasma frequency will be unable to propagate within the plasma. Furthermore, even if the radar wave frequency is not suitable for attenuation, it will likely be refracted (scattered) due to the transition of the radar energy from an optically denser medium into an optically thinner medium (the plasma).

A more involved discussion of plasma physics is necessary to achieve a significant level of understanding of how plasmas are formed, manipulated and interact with radar energy. Such a discussion, which involves determination of plasma dielectric constants, propagation constants, plasma confinement, collision transport and a host of Magneto Hydro Dynamic (MHD) phenomena, extends beyond the scope of a white paper into the realm of involved technical reports, dissertations and books. The purpose of this white paper is in part to acknowledge that a basic information base regarding the usefulness of a plasma to absorb or refract radar energy is readily available and with appropriate application of engineering, can be used to develop an active stealth technology focused upon handling a wide range of threat frequencies-radar bands.

CAVITIES MAKE A DIFFERENCE

Principal research into plasma active stealth has been conducted by the U.S. DoD at a variety of levels since the 1980s, with investigations into plasma physics in general for a variety of defense applications occurring since the 1950s. The most publicly acknowledged discussions of plasma active stealth derive, however, from Russia where the Ekurdsh Scientific Research Center³ has introduced a third-generation stealth system which results in the formation of a specific plasma around the outside of an aircraft, allowing the external contours of the aircraft to remain unaltered. This is extremely advantageous as it does not require the extensive aerodynamic compromises often associated with the design of a stealth aircraft. This particular system, which is said to weigh less than 220 lbs and require less than 10Kw to operate has the potential to equip existing aircraft, reducing their effective RCS to less than 1/100th of the original value. This plasma system is said to result in a level of stealth on the order of that achieved in the F-117 and B-2 platforms, yet with significantly lower procurement and total life-cycle costs. Academic Anatoliy Korteev has served as a POC for the work performed at the M.V. Keldysh research center.

The Russians have been involved in the study/development of active plasma stealth technology for probably as long as the USAF and at one time intended to field this type of technology, named *Marabu*, in the AS-X-19 strategic cruise missile, however the program to do so was cancelled in the early 1990s.

While STAVATTI acknowledges the Russian effort and the fact this technology may be directly applied to their fifth generation fighters, their publicized approach which focuses upon encompassing the external skin of an aircraft in a plasma is perceived as technically challenging due to the possible difficulties of:

- 1) generating a plasma of adequate density and stability to achieve the appropriate cut-off conditions in aerodynamic free-stream conditions.
- 2) Ensuring the magnetic wave propagation properties are not too complex to manage when subjected to non-homogeneity or during 6-plus axis motion during high-speed aircraft maneuver
- 3) Generating a plasma by a means (non-microwave) which does not result in EM signature emission.

As previously noted, a potentially more manageable approach to plasma active stealth is being explored by ONERA which is conducting the initial technical feasibility of generating plasmas not only around an airframe, but within the confines of cavities within the aircraft. The generation of plasma fields within the confines of a radome to shield active phased array radar antennas is of principal focus.

Such a cavity approach enables a more effective plasma generation and control, particularly from the standpoint of removing the plasma from any aerodynamic free stream which compounds already existing MHD/fluid mechanics complexities. In essence, it is STAVATTI's argument that the confinement of a plasma within aircraft structural cavities actually permits the development and fielding of a truly reliable and resilient active stealth system.

F-26 STALMA RCS REDUCTION AND COPCAST

STAVATTI began an investigation of plasma active stealth technology from the onset of STALMA design, incorporating the technology as a major airframe feature in 1995, resulting in the election of an appropriately engineered double-hull aircraft skin configuration. The trademark double hull of the F-26 platform has been openly circulated within the public domain since 1997, however, the specific use of this structural element as a component of LO technology was not indicated until 1999-2000. The actual admission by STAVATTI that a plasma based active stealth technology was integral to the STALMA platform was not released until 9 August 2004, coinciding with the AW&ST article "Furtive Exploration" indicating this technology was being openly developed by the French defense research organization ONERA "to mask RF energy bright spots within enclosed spaces, such as inside the aircraft's radome" on page 24. STAVATTI interpreted this article on French Plasma Active Stealth development as an ice-breaker, enabling preliminary admissions of STAVATTI's contribution to the art. Additionally, recent marketing plans focused upon the export of STALMA aircraft to INDIA prompted additional public domain disclosure of this advanced approach to aircraft LO.

To understand STALMA LO characteristics with regard to RCS, it is important to have a basic understanding of the aircraft geometry. The F-26 STALMA is a single engine, single seat aircraft of three surface configuration consisting of forward swept canards (32° sweep with 3° dihedral), a variable geometry wing (with 5° to 70° sweep and 0° dihedral) and a V-empennage (with 52° reference sweep and 55° dihedral). As the aircraft is a swing-wing design, it was inherently difficult to achieve reduced RCS by planform alignment, hence alternative methods of RCS reduction were required. Fig 1 provides a General Arrangement drawing of the F-26 STALMA.

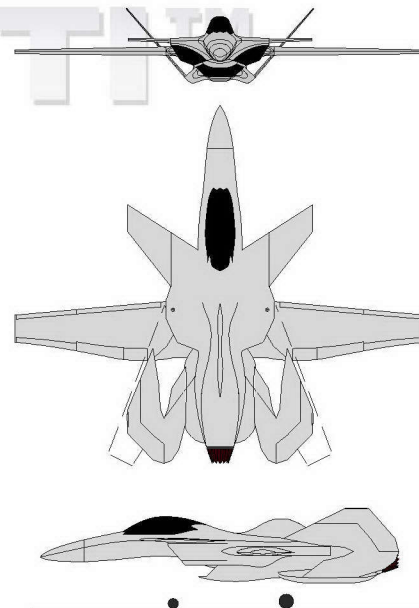


Fig 1 STALMA GA

To reduce RCS, the STALMA employs a geometrically based radar disbursing configuration. Developed utilizing computational RCS modeling techniques employed and/or developed by Stavatti, the STALMA configuration employs facets approximated by curvilinear, polynomial sections. Such facets can be recognized by examining specific aircraft cross sections including those associated with the nose and air intake sections as found in Fig 2. Similarly, the dihedral of the empennage is of value in reducing RCS in a variety of flight attitudes. The use of facets does reduce RCS, as does the significant degree of wing-body blending at the wing juncture.

Unlike the F-117, the STALMA employs largely conventional airfoils with only slight modification. These airfoils are found in the wing, canard and empennage and by virtue of their configuration would result in an inherently high RCS. Furthermore, these lifting sections, the wing in particular, incorporate very complex, high lift devices including double slotted Fowler Flaps. Generally speaking, the overall use of Fowler flaps on a swing wing design led to significant signature reduction challenges. To achieve a reduced RCS, all control/flap surfaces are constructed from bandpass materials, treated with RAM where necessary to ensure low RCS. The all-moving canard is constructed primarily from a monocoque bandpass structure

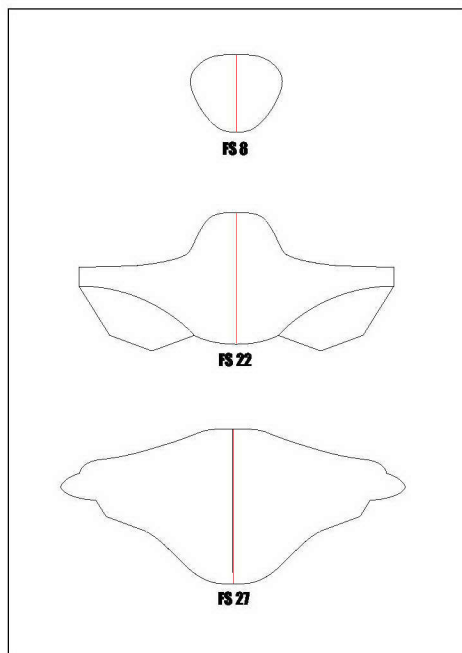


Fig 2 FUSELAGE CROSS SECTIONS

wherein all canard substructure (including spars, ribs and stringers) is of RCS engineered faceted configuration and coated with RAM. Hence radar energy which is transmitted through the bandpass skins is scattered by a faceted internal structure. The all-moving upper empennage is of generally similar construction to the canard forplanes with the exception that the fixed, non-moving lower section incorporates radar reflecting graphite/polyimide skins angled in such a manner to reduce signal return. Thus lifting surfaces which do not harbor significant internal devices employ a combination of bandpass materials and faceted internal structure members to ensure a low RCS.

Reduction of fuselage and wing element RCS required a completely different approach than the canards, empennage and flight controls. Although faceting is incorporated in the design, as stated earlier, there are inherent shortcomings in the utilization of the shape/materials approach to stealth. As such, achieving a low, all-aspect fuselage and wing RCS is dependent upon a proprietary combination of bandpass external skins, internal shaping and the implementation of Cold-Plasma-Cavity Active Stealth Technology (COPCAST).

Elaborating upon this fuselage and wing masking technique, as indicated in Fig 3 and Fig 4, both the external skin and internal hull of STALMA fuselage/wing sections are of similar geometry. The external skin is of high temperature⁴ band-pass type which fundamentally permits the unimpeded transmission of threat radar energy. The internal skin/hull, composed of graphite/high temperature resin backed by an alloy geodetic structure (which serves as a Faraday cage for protection of avionics/systems), is physically separated from the external skin by between one and two inches, resulting in a cavity of one to two inch thickness around the bulk of the aircraft. The external skins are affixed to the graphite inner hull using a proprietary fastening system which includes the use of bandpass ribs which act both as structural attachments and spacers. As such, individual cavity cells are formed throughout the airframe. It is within these cavity cells that a plasma is achieved. Each individual cavity cell is structurally capable of not only sustaining external dynamic pressures, but +/- internal pressurization required to maintain a cold plasma.

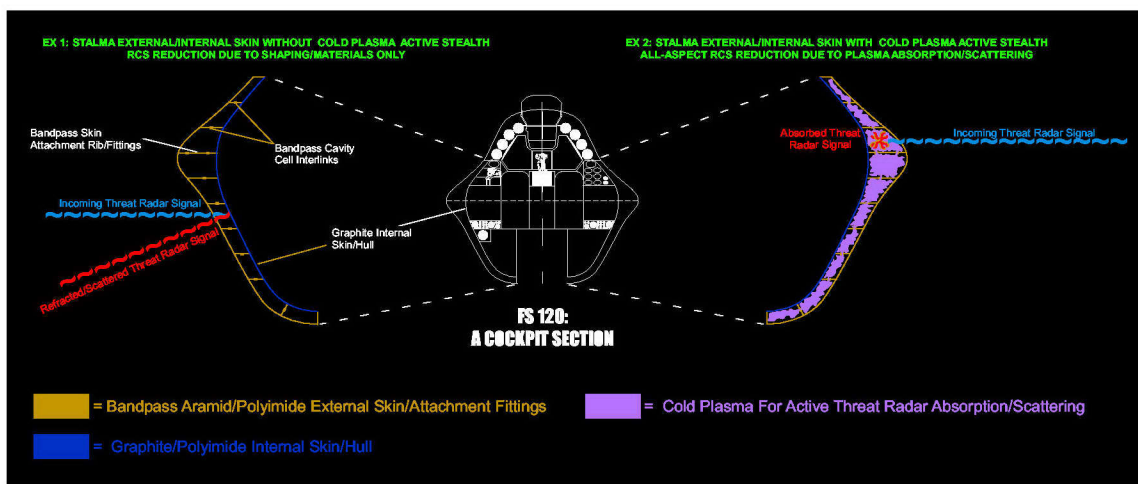


Fig 3 FUSELAGE COLD PLASMA CAVITY PLASMA ACTIVE STEALTH AT SAMPLE FS 120

Cold plasma cell cavities are inter-linked wherever possible to allow plasma flow through and maintenance of a consistent internal plasma pressure, similar in effect to the concept of an integral fuel tank/wet wing. Specific cells, such as access panels and landing gear bay doors are not inter-linked, but instead

are closed cell systems, with plasma being fed through flexible dielectric/RAM coated pressure cold plasma tubing from a central plasma distribution network. To limit complexity, the STALMA, as many stealth aircraft has a minimal number of panels and access hatches, with major avionic and systems servicing being performed through a few key multi-functional locations. That being said, the STALMA does have access panels where necessary to ensure ease of maintenance, relying upon the masking capabilities permitted by this unique stealth system. Unlike traditional aircraft, STALMA access panels and landing gear bay doors are approximately 1.5 to 3.0 inches thick, accommodating the plasma cavity cells. Attached using bandpass hinges and RAM fabricated rotational hardware, all STALMA hatches and panels employ proprietary fastening systems, latches and attachment fittings to ensure continuity of LO.

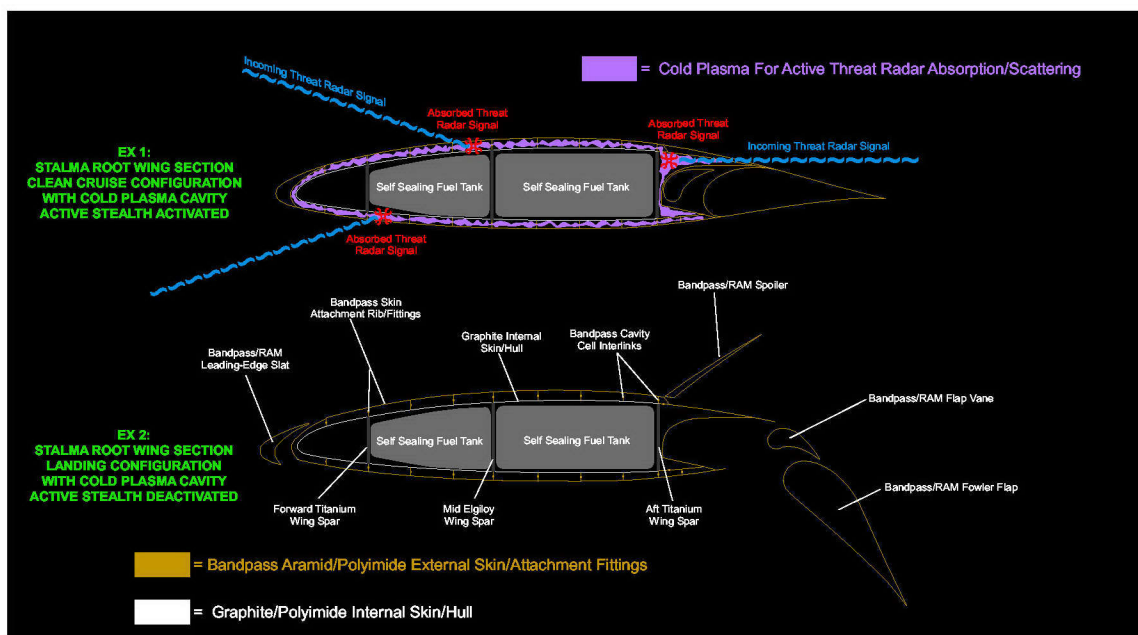


Fig 4 WING COLD PLASMA CAVITY PLASMA ACTIVE STEALTH AT SAMPLE ROOT CHORD

The heart of the COPCAST system is the cold plasma generator and distribution network. Cold plasma is utilized in this system due to the use of only moderately high temperature materials with maximum permissible design temperatures of approximately 500° F. Cold plasma is not only critical from the standpoint of material durability, but to ensure IR signature minimization. As a principal threat to combat aircraft is the fire-and-forget IR guided SRM, it is extremely desirable to have the mean temperature of the aircraft as near to or below ambient as possible. Additionally, in a cold plasma, the thermal movement of charged particles and corresponding interactions due to collisions of charge particles is limited, hence only the collective wave motion of the plasma is quintessential, slightly reducing the complexity of the plasma management system over one featuring higher plasmas, such as those evident in Russian systems.

Cold plasma generation is achieved through the use of a series of multiple plasmatrions specifically engineered by a STAVATTI Industry Team Member (ITM) for direct application in the STALMA and additional military air vehicle platforms. The plasmatrions are compact lightweight, resilient and designed to function at both greater than atmospheric pressure and within a vacuum. Power is supplied to the plasmatrions through the aircraft's 115 Volt, three phase, 400 cycle AC power system with total power consumption being on the order of the aircraft's Raytheon APG-79 multi-mode pulse Doppler radar system.

The plasmatrions supply a specific cold plasma to a distribution network which consists of a specific series of integrated cell cavities as previously discussed. The overall design of the plasma distribution network is conceptually similar to that of the aircraft fuel and hydraulic systems whereby a series of plasma generators, regulators and tanks/reservoirs (in this case cell cavities) are orchestrated to distribute plasma in a manner necessary to assure active RCS reduction. Plasma density is controlled at the point of generation, while frequency is controlled in part locally at the cell level. Each cell cavity has integral EM

management systems to provide a level of plasma manipulation. Critical elements of the plasma generation and distribution system are LRUs, enabling removal and replacement on a unit component level. Plasma manipulation, generation, distribution and overall management is the responsibility of the STALMA's computational network which accesses threat radar type and frequency via the aircraft's RWR and ECM/self protection system and subsequently intelligently manages the active stealth system.

Specific details regarding plasma generation, including gas mixtures employed for the generation of plasma, distribution network components and subsystems, including information relating to the plasma control system are STAVATTI proprietary and not available for public dissemination at this time.

While the F-26 STALMA does employ a plasma active stealth system within the confines of the nose radome to mask the aircraft sensor suite from threat interrogation, it is evident that the STAVATTI system is an evolution beyond what is being investigated at ONERA. Through confining the plasma within the airframe, potential adverse affects wrought by having a plasma field external to the aircraft (as in one Russian approach) are avoided.

Unlike the Russian system, however, the STAVATTI COPCAST approach requires a significant alteration in the structural design of the aircraft. Although requiring the use of sandwich style construction with relatively large web-members which effectively reduce total fuselage structural weight, there is an additional weight penalty through the application of this system incurred through the integration of unique systems and additional structure in the form of cell cavities. COPCAST is not a system which can be applied to existing aircraft, nor is it suitable for modified aircraft. COPCAST requires integration into entirely new airframe designs at the conceptual design stage. Furthermore, additional tooling, on the order of 40% more, is required in the fabrication of this type of platform. In the case of the F-26 STALMA, nearly all of this additional tooling takes the form of cast Invar molds for autoclave curing of high temperature composites, resulting in significant additional cost over a traditional alloy/composite structure. The STAVATTI system requires the development of not only unique plasma related generation, distribution and control systems, but opens an entirely new realm of interference/cancellation integration checks to both qualify and operate an aircraft with advanced avionics as well as active stealth. In general, platforms employing COPCAST are extremely complex from an EM/systems integration standpoint. The support and maintenance of such a plasma stealth system is likewise an unexplored matter which will likely add to an increase in total operational costs over conventional aircraft. Unlike traditional stealth aircraft, however, the STALMA equipped with COPCAST requires no specific/specialized surface maintenance or treatments. As the driving elements behind achieving COPCAST are provided by LRUs, maintenance of the "stealth" element of the STALMA aircraft is significantly less complex than F-117, B-2 or F-22 aircraft.

EXPORTABILITY

The COPCAST system as featured in the F-26 STALMA is an advanced approach to LO technology which ultimately results in a sixth generation class combat aircraft with commensurate stealth characteristics. As such, while the F-26 STALMA with COPCAST may be exportable to close U.S. NATO member allies, as well as Australia and Japan, export of the aircraft to allies including India, Taiwan and South Korea may be significantly limited due to National Disclosure Policy.

To permit the export of F-26 STALMA aircraft to allies who are limited by National Disclosure Policy, the LRU/system approach to LO provided by COPCAST enables STAVATTI to produce F-26 variants which lack all necessary COPCAST components. Such COPCAST omitted STALMA variants would instead rely solely upon the interplay of external/internal shaping (Fig 3 Ex 1), resulting in an RCS on the order of 5 to 25 sq inches. Furthermore aircraft not featuring COPCAST would enable the integration of additional ballistic aramid/composite armor within the vacant aircraft cavities, providing a degree of physical survivability. In short, the COPCAST system is an LRU approach to stealth, enabling the aircraft to be marketed worldwide via DCS or FMS in both stealth and non-stealth variants alike.

Consequently, the COPCAST system allows the STALMA to be flown as a "stealth fighter" when COPCAST is powered and as a non-stealth aircraft when COPCAST is "turned-off." This unique feature inherent to plasma active stealth system allows combat aircraft to actually have the proverbial "stealth modes" as pioneered in science fiction and modern video games alike!

CONCLUSION

The purpose of this white paper is to provide a general overview of a unique conceptual approach to plasma active stealth, as well as RCS reduction in general. Readers are to come away with an understanding that one particular method for achieving active stealth rests within the confinement of a plasma within an airframe composite sandwich structure. This double-hull approach, while industry standard in the construction of ocean-going vessels ranging from oil tankers and battleships to cruise-liners, is a significant deviation from the traditional aluminum alloy based semi-monocoque approach to aircraft construction which has dominated the industry since the mid-1930s.

In STAVATTI's estimation, the COPCAST system when initially fielded in the F-26 STALMA weapon system will provide an unparalleled level of active stealth technology whereby incoming interrogative radar energy is substantially disrupted such that return signal is mitigated to undetectable levels or chaotic, undecipherable signals. Rather than rely solely upon external shaping, Stavatti proprietary F-26 stealth technology adapts to frequency and bandwidth, allowing maximum LO performance against all air-to-air and ground based radar types alike. F-26 clean, all-aspect RCS is on the order of 0.006 square meters. In so doing, the STALMA will be one of few next generation stealth fighters which will be able to operate from unprepared, forward locations with minimal support requirements without question or sacrifice of all-weather, day/night capability or increased or unique visual signature. Ultimately the system will save money while winning wars.

While extremely beneficial to combat aircraft of novel design, the COPCAST approach is conceptually adaptable to a wide range of vehicles and vessels, for both land and sea, requiring a robust LO solution.

For additional information regarding COPCAST™, the F-26 STALMA™ MRF or other STAVATTI products and services, contact our headquarters at:

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1: Sweetman, Bill Inside the Stealth Bomber, Copyright © 1999 Bill Sweetman/MBI Publishing Company, Osceola, WI

2: Jenn, David C. Radar and Laser Cross Section Engineering, Copyright © 1995 American Institute of Aeronautics and Astronautics, Inc., Washington D.C., Section 7.8 Active Cancellation pp. 330-331

3: Yangjian, Deng Technical Analysis of Plasma Active Stealth, NAIC-2001-00152-HT, Translated by NAIC/DXOP, 8 March 2001

4: External skins are composed of aramid/RP-46 polyimide resin. RP-46 is a high temperature matrix material developed by Ruth Pater, Ph.D., at NASA Langley as a non-toxic alternative to AFR-700B and a successor to PMR-15. RP-46 figures of merit include an operational temperature in excess of 500° F which may be maintained continuously for over 10,000 hours without degradation or delamination.